HORTICULTURE DEPARTMENT SERIES 490 AUGUST 1980

1980 TOMATO PROCESSING RESEARCH PROJECTS

OHIO AGRICULTURAL RESEARCH AND DEVELOPMENT CENTER
U. S. 250 and Ohio 83 South
Wooster, Ohio

PREFACE

The attached brief outline enumerates the various research projects covering the activities underway to assist the Ohio tomato industry. Further information on any of these research activities or other activities may be obtained by contacting the individual research staff member or the various departments or the administration at the Ohio Agricultural Research and Development Center, Wooster, Ohio. Following these brief outlines, a list of faculty and staff specialists, county agents and area Extension Agents concerned with tomatoes are given to you for further assistance. In addition to activities reported herein, there are several graduate students conducting research in various aspects directly related to problems confronting the Ohio tomato industry. The graduate student research programs are advised by the faculty and the graduate students play a significant part in the total research effort.

H. A. Rollins

H.A. Rollins, Chairman
Department of Horticulture

INDEX

PROJECT TITLE: Development and Evaluation of Improved Mechanically Harvestable Processing Tomatoes

PERSONNEL: (LEADER) S.Z. Berry
(OTHERS) W.A. Gould

DEPARTMENT: Horticulture

OBJECTIVES:

1. To develop a series of mechanically harvestable whole-pack type tomatoes for the Ohio canning industry which possess:
   a) a series of maturities from early to main season.
   b) germination cold tolerance and improved seedling vigor.
   c) wide adaptability particularly in regard to fruit setting ability.
   d) concentrated ripening of fruit with uniform maturity.
   e) fruits which are resistant to cracking and breakage.
   f) high yield standards.
   g) fruit with jointless pedicel free-stemming characteristics and small core adaptable to efficient automated peeling.
   h) fruit with improved levels of acidity, flavor, solids, wholeness, ascorbic acid (Vitamin C), Vitamin A, and better color.
   i) resistance to Fusarium and Verticillium wilts and Anthracnose.
2. To test introductions from this program and from other breeding programs for the processing industry of northwestern Ohio with special emphasis on yield, suitability for mechanical harvest and quality of the raw and finished product.

PROJECT STATUS

In 1980 there was an increase in commercial acreage planted of the new machine harvest jointless pedicel cultivar Ohio 7663, as a choice for early season whole-pack production. Field results continued good and in-plant processing evaluation demonstrated that this cultivar had excellent peeling characteristics and small core.

07681, which is in commercial trial, has excellent productivity and large fruit size and has exhibited wide adaptability. It is a Verticillium-Fusarium resistant, firm, high quality line adapted to hand or machine harvest, primarily for product use.

07814, an early Fusarium resistant, jointless pedicel, machine harvest type, exhibited good potential in commercial trials. It is firm and suitable for coreless whole-pack use.

07864 and 07870 are jointless pedicel, main season, machine harvest lines which performed well in commercial trial. These Verticillium-Fusarium resistant, firm types are adapted for use in coreless whole-pack.

07868 and 07869 are main season Verticillium-Fusarium resistant Crimson types which have exhibited potential in commercial trials for hand harvest, as well as machine harvest. They are firm and suitable for product or whole-pack.

Several new breeding lines are available which exhibit potential for improvement in productivity and quality over present varieties. These lines are being extensively tested and used in crossing to develop newer types with more desirable combinations of productivity and quality utilizing the highest levels of these characteristics available in a range of different breeding backgrounds and maturities. The need for a greater choice of suitable types remains. New lines and varieties from other sources were also included in these studies.

PROJECT TITLE: PLANT REGULATORS - FRUIT SET AND MATURITY

PERSONNEL: Dale Kretchman

DEPARTMENT: Horticulture

OBJECTIVES: To develop methods for improving fruit set and control of maturity on processing tomatoes.

PROJECT STATUS

Plant growth regulators are used in the propagation industries to improve rooting and early growth of plants propagated by cuttings. It appears that one or more of these regulators may be helpful in plant establishment after transplanting and it appears to result in earlier, more uniform maturity. Label establishment may be several years in the future. Another growth regulator shows dramatic improvement in yields of up to 7 tons per acre and is very effective in setting fruit. Clearance of this compound may be only a few years away. Other experimental materials are being investigated.

PROJECT TITLE: PLANT NUTRITION - N RATE AND TIMING AND MICRONUTRIENTS

PERSONNEL: Dale Kretchman

DEPARTMENT: Horticulture

OBJECTIVES: To determine the optimum rate and time of application for nitrogen fertilizer and to evaluate the usefulness of certain newer micronutrients on processing tomatoes.

PROJECT STATUS

This is the second year of this study with N to determine its most effective use on some of the newer, smaller vine-type processing tomatoes. Varieties include Heinz 2653, Peto 80, Libby 8990A and Campbell 37. Single and twin rows are also variables. N treatments for 1980 include both pre- and post-transplanting application of N as ammonium nitrate or calcium nitrate with a maximum rate of 100 lbs/A of N for any combination. Preliminary results suggest that an early side-dress of about half the total N used is advantageous for the very early, small vine types like Heinz 2653. Later or large vined varieties appear less responsive to side-dress applications.

Micronutrient studies are just starting but one obvious conclusion is that chelated micronutrients where EDTA is the chelating agent, should <u>not</u> be included in the starter solution used with transplants. The EDTA is highly toxic to tomato transplants.

PROJECT TITLE: FIELD SEEDING - METHODS AND ANTI-CRUSTANTS

PERSONNEL: Dale Kretchman

DEPARTMENT: Horticulture

OBJECTIVES: To determine the effectiveness of certain anti-crustant treatments on stand establishment with several methods of field seeding.

PROJECT STATUS

Much of the field seeding work was done several years ago and the results indicated that anti-crustants are highly desirable on the fine-textured clay loam soils in Northwestern Ohio and that the most reliable field seeding method was the plug-mix technique. However, the studies were conducted prior to the development of the gel seeding technique. Included in the 1980 studies were gel seeding with and without vermiculite anti-crustant or Nalco 2190 as well as several standard methods. Further, one-half inch of irrigation was applied 2 days after seeding to ensure crusting.

Preliminary results indicate that, 1) plug-mix seeding of either raw or pre-germinated seed is still the most reliable method of stand establishment; 2) Nalco 2190 was not effective as an anti-crustant under these conditions; 3) using vermiculite anti-crustant at a rate of about 20 cu. ft./A in the furrow with the gel-seed resulted in nearly a 100% increase in stand, although the regular gel seeding gave an acceptable stand; 4) pre-germination reduced emergence time about 50%.

PROJECT TITLE: Weed Control in Tomatoes

PERSONNEL: S.F. Gorske

DEPARTMENT: Horticulture

OBJECTIVES: To evaluate several cultivars of processing tomatoes for tolerance to preplant incorporated treatments of metribuzin.

PROJECT STATUS

Seven cultivars: 1) UC 134-1-2, 2) Chico III, 3) Heinz 722, 4) C-28, 5) Heinz 2867, 6) C-37, and 7) Heinz 1706 of processing tomatoes are being evaluated for tolerance to preplant incorporated applications of metribuzin herbicide. Treatments consist of a 1) Check, 2) Sencor/Lexone, 3) Treflan and 4) Treflan plus Sencor/Lexone. During 1980 little or no phytotoxicity was noticed on the transplants. Yield data has yet to be collected.

Title: Tomato Harvest Mechanization

Personnel: R.G. Holmes (leader) and W.A. Gould, D.G. Kretchman, T.A. Short

Department: Agricultural Engineering

Cooperating Dept. or Agency: Ohio Food Processors Association

Objectives:

1. Investigate interactions between tomatoes of various varieties and maturities and a vibrating surface to better understand vibration sorting.

2. Design, construct and test prototype vibration sorters in a processing plant and on a field harvester.

3. Study sorting effectiveness of a vibratory sorter in a tomato processing plant to evaluate the potential and feasibility of maturity grading prior to processing.

Project Status:

Laboratory tests conducted in the fall of 1974 indicated potential for sorting tomatoes by vibration. When process tomatoes were brought in contact with a vibrating surface, operating with an amplitude of 0.1 inch and frequency of 50-80 cps, it was observed that the green (firm) fruit bounced vigorously while the ripe (softer) fruit bounced very little. Subsequently, a vibratory sorter was designed utilizing a 24 inch long, offset, rotating cylinder covered by a non-rotating teflon fabric membrane. A mixture of ripe and green tomatoes was carried past the vibrator on an inclined 2 inch wide conveyor. The effectiveness of this system for maturity sorting depended very much on vibrator frequency of the green tomatoes (usually between 50-80 cps depending primarily on tomato firmness which of course depends on ripeness and variety). When the system was operated at the optimum frequency, typical sorting efficiencies were better than 90% green rejected and less than 3% ripe rejected.

The sorter design has recently been modified to eliminate the teflon fabric (a problem because of rapid wear and mud buildup). An oscillating cylinder replaces the offset roller in the earlier design. A two channel verson of this new sorter was tested using various mechanically harvested tomato cultivars.

In addition, several design modifications to existing mechanical harvesting systems have been evaluated to make these systems more adapted to Ohio tomato growing conditions. Some of these include alternative cultural practices and machine pickup combinations to reduce mud pickup, improved tomato transport systems for getting the harvested fruit out of wet soggy fields, and design changes to make the harvester smaller, lighter and more mobile. Present emphasis is on maturity sorting of tomatoes at the processing plant prior to packing to predict finished product quality.

Title: Raw Product Color Evaluation - W.A. Gould, Project Leader, N.B. Curtner, Tim Glaros, Jeff Kinzbach, Sandra Kuo and Liz Entwisle

Department: Horticulture and Ohio-Federal State Inspection Service

Objectives:

1. To evaluate different raw juice extraction methods for color evaluation.

2. To evaluate different color measuring instruments for color evaluation.

3. To correlate systems of raw product grading of tomatoes and to relate these to finished product grades of the canned products.

Project Status:

Tomatoes are generally purchased from growers on the basis of US Grades. The US Grades are primarily based on color and freedom from defects including mold. Color may be determined visually or, more recently, objectively by using a color instrument. The objective evaluation of color in the US standards for grades for tomatoes is determined on the basis of an extracted sample using a USDA approved extractor fitted with a 0.034 inch screen and presenting the sample to a Hunter Tomato Color meter. The tomato color index shall be not less than 63.

The California tomato grade is similar in many respects except that the color is determined by testing the color on a comminuted sample consisting of 8.5 lb. of tomatoes out of each 50 lb. inspection sample. The sample is blended in a gallon blender under 27 inch vacuum for 1 minute. The 175 ml. sample is taken with a ladle after inserting a 14-mesh wire screen into the blender and read on the Agtron E-5. The reading must not exceed 39 on the Agtron scale.

In 1980 eight Ohio grading stations will be selected and three or more visits will be made to each during the tomato processing season.

At each inspection (minimum of 72), a raw sample from the graders sample will be taken for extraction with the Berkel (USDA extractor) and extracted with the California system. In addition, a sample of the USDA extracted juice if the station is grading will be evaluated with the aid of the TCM instrument.

All samples will be evaluated with the TCM and Agtron E-5 instrument and for mold using the newly developed OSU mold counting method.

In addition, a subsample from each will be heated to 200°F and held for 15 minutes, cooled and evaluated for color on the TCM and Agtron E-5 Color instrument. These values will be correlated to the raw unheated sample and to finished products where applicable.

Title: Processing Efficiency and Market Acceptability of Cultivars of Tomatoes for Canning

Personnel: W.A. Gould (leader), S.Z. Berry, James Bass, Kip Warnke, Tim Glaros, Jeff Kinzbach, I. Wahem, Liz Entwisle, Marilyn Graham, Dan Wampler

Department: Horticulture

Objectives:

1. To evaluate new cultivars; maturity within a cultivar; and mechanical harvesting, handling and sorting systems by cultivar on canned product quality and market acceptability of tomatoes and tomato products.

2. To evaluate unit operation of sorting, washing, peeling, extraction and milling, filling, and processing on canned tomatoes and on juice and concentrated tomato products manufactured as to effects on canned product quality and market acceptability.

3. To determine the effect of food additives (acidulants, sweeteners, firming agents and spices) on quality and market acceptability for canned tomatoes, juice and concentrated tomato products.

Project Status:

In 1979 thirty-six new cultivars were evaluated for mechanical harvest, bulk handling, specific gravity separation and processing. The 1979 crop had very low citric acid content (0.22 to 0.35), pH's up to 4.60 and soluble solids as low as 3.8%. These values are considerably inferior to any previous experiences and they are reflected in the very high sugar-acid ratios of the canned tomato juice. Further, some spoilage was observed on the acidified canned tomato pack. The highest quality commercial variety in 1979 was Heinz 2867 for both juice and whole pack products. Ohio 7814 and 7855 were equivalent to the Heinz cultivar for canned whole pack quality while Ohio 7858, 7864, 7869, 7870 were equal on juice quality.

In 1980 trials include eighteen new Ohio advanced cultivars plus ten new commercial cultivars. (See below.) The plots will be mechanically harvested when each cultivar reaches 75% mature useable fruits. There will be no sort on the harvester and the tomatoes will be handled in bulk equipment. Following delivery at the pilot plant in Columbus, the tomatoes will be specific gravity separated with the aid of water with the useable fruits canned as whole tomatoes and/or manufactured into tomato juice or concentrates.

1. Campbell 37
2. Hunts 304
3. Campbell CX 793
4. Heinz 2653
5. Heinz 722
6. Heinz 727
7. Peto 80
8. Ohio 7663
9. Ohio 7630
10. Ohio 7681
11. Ohio 7814
12. Ohio 7864
13. Ohio 7868
14. Ohio 7869
15. Ohio 7826
16. Ohio 7832
17. Ohio 7843
18. Ohio 7855
19. Ohio 7858
20. Ohio 7870
21. Ohio 7874
22. Ohio 7893
23. Ohio 7974
24. Ohio 7980
25. Ohio 7986
26. Ohio 79138
27. Ohio 79165
28. Ohio 79171

Title: Insecticide Evaluation on Processing Tomatoes

Personnel: D. E. Simonet (leader), Greg Walker (associate); R. B. Chalfant, Dept. of Entomology, Coastal Plains Experiment Station, Tifton, Georgia (cooperating).

Department: Entomology

Objectives and Status:

This project involves the evaluation and development of new insecticides for use against insect pests on processing tomatoes in Ohio. Particular emphasis is being placed on early season protection against Colorado potato beetle through the use of soil systemics.

In the future, evaluations will be made comparing efficacy of systemic insecticide applied in Georgia to transplants shipped to Ohio, and transplants receiving systemic insecticide at planting in Ohio.

Title: Insect Thresholds for Processing Tomatoes

Personnel: D. E. Simonet (leader), Greg Walker (associate); D. W. Kretchman, Dept. of Horticulture, OARDC (cooperating)

Department: Entomology

Objectives and Status:

This study deals with the development of economic threshold levels for making control decisions against the Colorado potato beetle and potato aphid on direct seeded and transplant tomatoes for processing. It appears that this is primarily an early season problem and future work will deal with the influence of beetle populations in relation to planting date and height on tomato yields.

Also, a study on the impact of the potato aphid on tomato yield and quality is being conducted. In conjunction with this study, a survey for natural enemies of the potato aphid on tomatoes is being made. We hope to implement this information into the current pest management program on processing tomatoes in Ohio.

Appendix 1

FACULTY AND STAFF SPECIALISTS CONCERNED WITH TOMATOES FOR PROCESSING

Name	Title	Address
Dr. S.Z. Berry 216-264-1021	Horticulture (Tomato Breeding)	O.A.R.D.C. Wooster, OH 44691
Dr. M.E. Cravens 614-422-8012	Extension Economist Fruit & Vegetable Marketing	2120 Fyffe Road Columbus, OH 43210
Dr. James D. Farley 614-422-6397	Extension Plant Pathologist	1735 Neil Avenue Columbus, OH 43210
Dr. J.R. Geisman 614-422-5169	Horticulture, Food Technologist (Waste Disposal & Fermentation)	2001 Fyffe Court Columbus, OH 43210
Dr. Stan Gorske 614-422-9775	Horticulture (Weed Control)	2001 Fyffe Court Columbus, OH 43210
Dr. W.A. Gould 614-422-7004	Horticulture, Food Technologist (Processing & Quality Evaluation)	2001 Fyffe Court Columbus, OH 43210
Dr. Robert Holmes 614-422-6306	Agricultural Engineering (Harvesting & Processing)	2073 Neil Avenue Columbus, OH 43210
Dr. Dale Kretchman 216-264-1021	Horticulture (Vegetable Production & Physiology)	O.A.R.D.C. Wooster, OH 44691
Dr. William Lyon 614-422-5274	Extension Entomologist	1735 Neil Avenue Columbus, OH 43210
Dr. Richard Miller 614-422-5274	Extension Entomologist	1735 Neil Avenue Columbus, OH 43210
Mr. Melville Palmer 614-422-6740	Extension Agr. Engineer (Water Management)	2073 Neil Avenue Columbus, OH 43210
Dr. James Sargent 614-422-5274	Extension Specialist Pesticide Chemicals	1735 Neil Avenue Columbus, OH 43210
Dr. Ted Short 216-264-1021	Agricultural Engineering (Cultural Systems)	O.A.R.D.C. Wooster, OH 44691
Dr. Donald Simonet 216-264-1021	Entomology (Insect Control)	O.A.R.D.C. Wooster, OH 44691
Mr. E.C. Wittmeyer 614-422-2145	Extension Horticulturist Vegetable Production	2001 Fyffe Court Columbus, OH 43210

AREA AGENTS INVOLVED IN TOMATO PROCESSING ACTIVITIES

Mr. Karl V. Clemons 419-784-3838	Area Extension Agent Farm Management	North Clinton St., Rt. 2 Defiance, OH 43512
Mr. Marion E. Kroetz 419-784-3838	Area Extension Agent Agronomy	North Clinton St., Rt. 2 Defiance, OH 43512
Dr. Walter H. Schmidt 419-332-1594	Area Extension Agent Agronomy	1401 Walter Avenue Fremont, OH 43420
Mr. Carl Ruff	Area Extension Agent Farm Management	1401 Walter Avenue Fremont, OH 43420

COUNTY EXTENSION AGENTS WORKING IN MAJOR TOMATO PROCESSING COUNTIES

County	Name	Address
Allen	Mr. Calvin M. Leimbach 419-222-9946	219 W. Northern Ave. Lima, OH 45801
Auglaize	419-738-2219	Court House Wapakoneta, OH 45895
Darke	Mr. Dennis K. Baker 513-548-5215	Court House Greenville, OH 45331
Defiance	Mr. William F. Rohrs 419-782-4771	Court House, Box 448 Defiance, OH 43512
Erie	Mr. Floren V. James 419-626-9440, Ext. 253	1200 Sycamore Lane Sandusky, OH 44870
Fulton	Mr. Dean A. Parker 419-337-5515	122 Depot Wauseon, OH 43567
Hancock	Mr. Harry L. Freeman 419-422-3851	349 Trenton Avenue Findlay, OH 45840
Hardin	Mr. Edison Klingler 419-675-6262	Court House Kenton, OH 43326
Henry	Mr. Robert W. Cole 419-592-0806	Court House Napoleon, OH 43545
Lucas	Mr. Ralph Kittle 419-259-6364	Federal Building 234 Summit Street Toledo, OH 43604
Mercer	Mr. Marion E. Freeman, Jr. 419-586-2179	Court House Celina, OH 45822

Ottawa	419-898-3631	Federal Building Oak Harbor, OH 43449
Paulding	Mr. David A. Jones 419-399-3731	PO Box 71 Paulding, OH 45879
Putnam	Mr. Donald E. Kimmet 419-523-6294	219 South Oak Street Ottawa, OH 45875
Sandusky	Mr. Glenn Maddy 419-332-5581	1401 Walter Avenue Fremont, OH 43420
Seneca	Mr. Wenrich Stuckey, Jr. 419-447-9722	155½ E. Perry Street Tiffin, OH 44883
Van Wert	Mr. George E. Ropp 419-238-1214	Fairgrounds 1055 S. Washington St. Van Wert, OH 45891
Williams	Mr. Gerald D. Stanley 419-636-5608	1122 W. High Street Bryan, OH 43506
Wood	Mr. Richard B. Farison 419-352-6531, Ext. 2233	1 Court House Sq. Bowling Green, OH 43402
Wyandot	Mr. Ronald G. Courtright 419-294-4931	Court House Upper Sandusky, OH 43351

THE VEGETABLE CROPS BRANCH

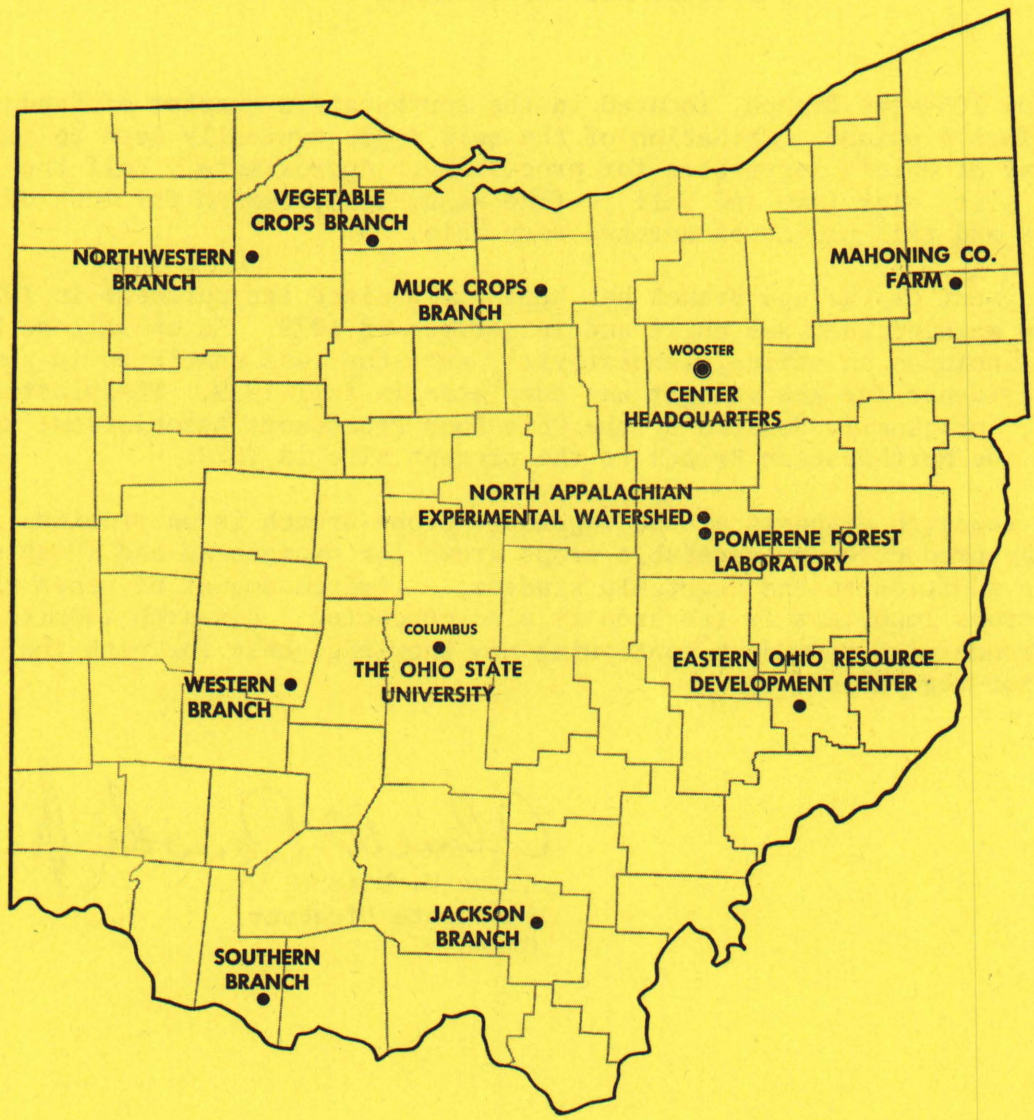
The new 105-acre Branch, located in the southwestern quarter of Sandusky County, offers a unique combination of the soil types typically used to grow the majority of Ohio's vegetables for processing. Approximately half the acreage is silty clay loam and half is fine sandy loam, common for most of the lake plains and till plains of northwestern Ohio.

Development of the new Branch has been rapid since its purchase in 1978. A pole-type machine shed was built and in service in 1979. An operations building, which includes an office, laboratories, and shop, was completed in summer 1979. A residence for the manager was completed in fall 1979. The plastic greenhouse, originally donated by the Ohio Food Processors Association, was moved from the Northwestern Branch to the present site in 1979.

Major research emphasis at the Vegetable Crops Branch is on problems related to the production of vegetable crops grown for processing and fresh marketing. In addition to the vegetable studies, a limited amount of research with agronomic crops important to the area is also conducted. Research results from this new Branch will provide a continuing new knowledge base for both the farmer and processor vegetable crops.

Clive W. Donoho, Jr.
Associate Director
OARDC

The State Is the Campus for Agricultural Research and Development



Ohio's major soil types and climatic conditions are represented at the Research Center's 12 locations.

Research is conducted by 15 departments on more than 7000 acres at Center headquarters in Wooster, eight branches, Pomerene Forest Laboratory, North Appalachian Experimental Watershed, and The Ohio State University.

Center Headquarters, Wooster, Wayne County: 1953 acres

Eastern Ohio Resource Development Center, Caldwell, Noble County: 2053 acres

Jackson Branch, Jackson, Jackson County: 502 acres

Mahoning County Farm, Canfield: 275 acres

Muck Crops Branch, Willard, Huron County: 15 acres

North Appalachian Experimental Watershed, Coshocton, Coshocton County: 1047 acres (Cooperative with Science and Education Administration/Agricultural Research, U. S. Dept. of Agriculture)

Northwestern Branch, Hoytville, Wood County: 247 acres

Pomerene Forest Laboratory, Coshocton County: 227 acres

Southern Branch, Ripley, Brown County: 275 acres

Vegetable Crops Branch, Fremont, Sandusky County: 105 acres

Western Branch, South Charleston, Clark County: 428 acres